AMENDMENTS TO THE CLAIMS

Claims 1-25 are canceled and Claims 28, 39, and 43 are amended as follows:

Claims 1-25 (canceled)

26. (original) A molecular system capable of undergoing an electric field induced band gap change that occurs via one of the following mechanisms:

(1) molecular conformation change or an isomerization;

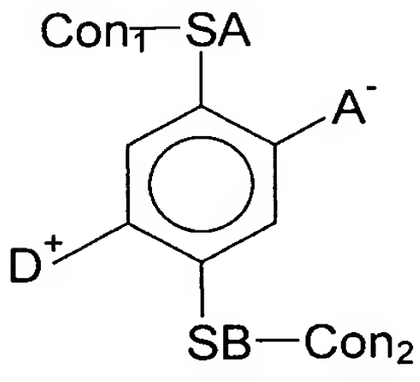
(2) change of extended conjugation via chemical bonding change to change the band gap; or

(3) molecular folding or stretching.

27. (original) The molecular system of Claim 26 wherein said electric field induced band gap change occurs via molecular conformation change or an isomerization.

28. (currently amended) The molecular system of Claim 27 comprising at least one stator portion and at least one rotor portion, wherein said rotor rotates from a first state to a second state with an applied electric field, wherein in said first state, there is extended conjugation throughout said molecular system, resulting in a relatively smaller band gap, and wherein in said second state, said extended conjugation is ~~destroyed~~ changed, resulting in a relatively larger band gap.

29. (original) The molecular system of Claim 28 comprising:



where:

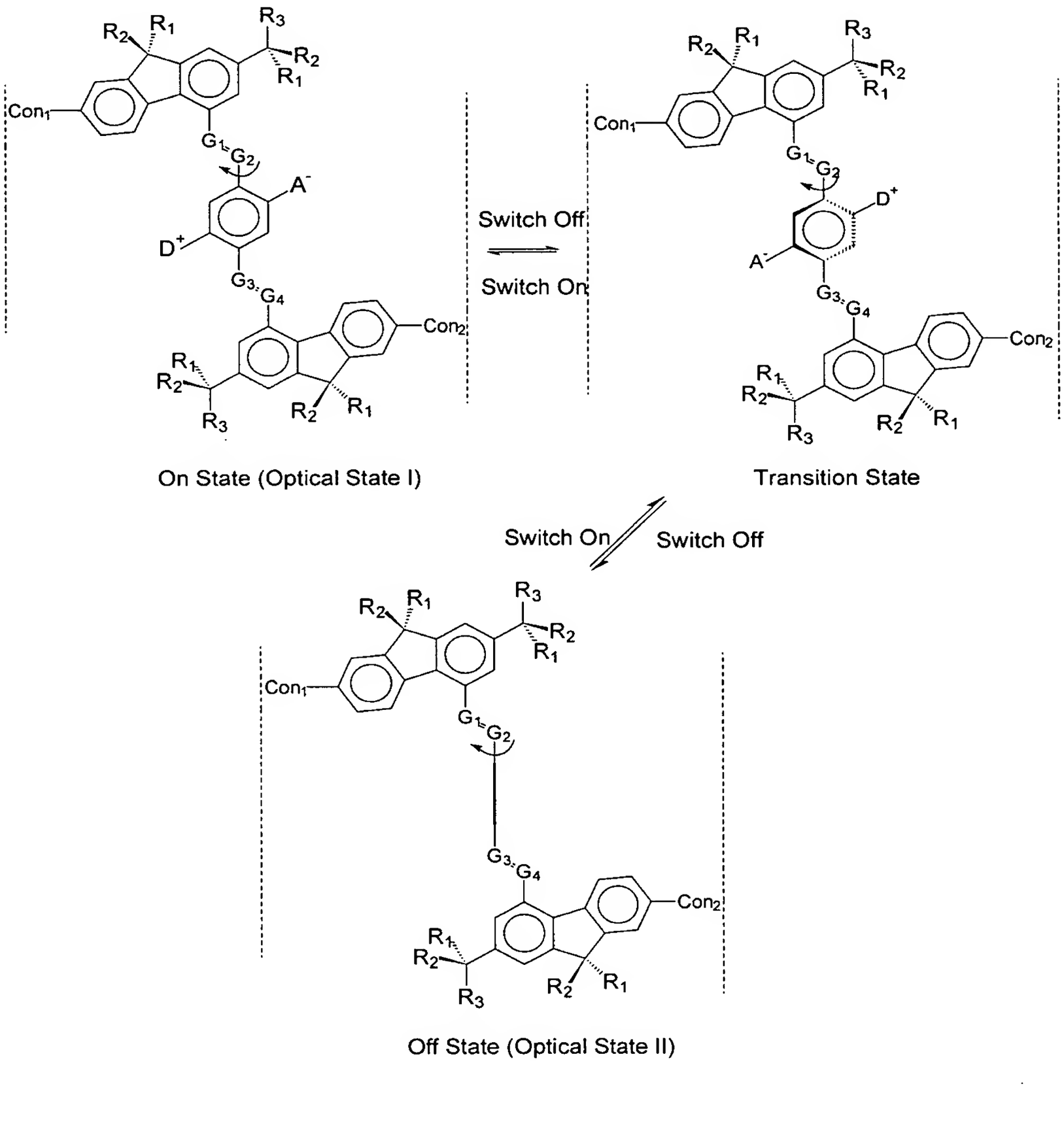
A^- is an Acceptor group comprising an electron-withdrawing group selected from the group consisting of: (a) hydrogen, (b) carboxylic acid and its derivatives, (c) sulfuric acid and its derivatives, (d) phosphoric acid and its derivatives, (e) nitro, (f) nitrile, (g) hetero atoms selected from the group consisting of N, O, S, P, F, Cl, and Br, (h) functional groups with at least one of said hetero atoms, (i) saturated or unsaturated hydrocarbons, and (j) substituted hydrocarbons;

D^+ is a Donor group comprising an electron-donating group selected from the group consisting of: (a) hydrogen, (b) amines, (c) OH, (d) SH, (e) ethers, (f) saturated or unsaturated hydrocarbon, (g) substituted hydrocarbons, and (h) functional groups with at least one hetero atom selected from the group consisting of B, Si, I, N, O, S, and P, wherein said Donor group is more electropositive than said Acceptor group;

Con_1 and Con_2 are connecting units between one molecule and another molecule or between a molecule and a solid substrate selected from the group consisting of a metal electrode, an inorganic substrate, and an organic substrate, said connecting units independently selected from the group consisting of: (a) hydrogen (utilizing a hydrogen bond), (b) multivalent hetero atoms selected from the group consisting of C, N, O, S, and P, (c) functional groups containing said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons; and

SA and SB designate Stator A and Stator B, respectively, which may be the same or different and which are independently selected from the group consisting of (a) unsaturated or saturated hydrocarbons and (b) substituted hydrocarbons, wherein said hydrocarbon units contain conjugated rings that contribute to an extended conjugation of the molecule when it is in a planar state (red shifted state), wherein said stators optionally and separately contain at least one bridging group G_n, at least one spacing group R_n, or both, wherein said at least one bridging group is either (a) selected from the group consisting of acetylene, ethylene, amide, imide, imine, and azo and is used to connect said stators to said rotor or to connect at least two conjugated rings to achieve a desired chromophore or (b) selected from the group consisting of a single atom bridge and a direct sigma bond between said rotor and said stators and wherein said at least one spacing group is selected from the group consisting of phenyl, isopropyl, and tert-butyl and is used to provide an appropriate 3-dimensional scaffolding to allow molecules to pack together while providing rotational space for each rotor to rotate over a desired range of motion.

30. (original) The molecular system of Claim 29 comprising:



On State (Optical State I)

Transition State

Off State (Optical State II)

where:

A^- is said Acceptor group;

D^+ is said Donor group;

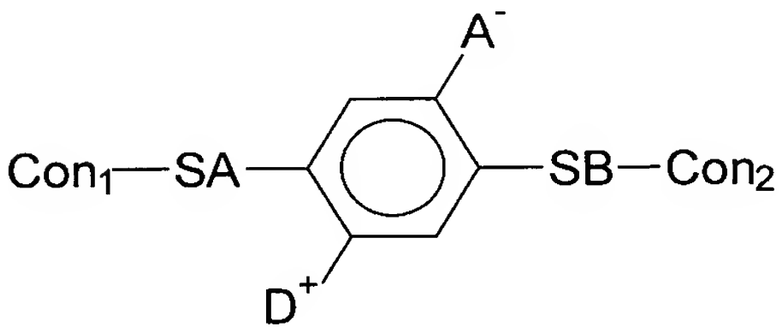
Con_1 and Con_2 are said connecting units;

R_1, R_2, R_3 are said spacing groups, which are independently selected from the group consisting of: (a) hydrogen, (b) saturated or unsaturated hydrocarbons, and (c) substituted hydrocarbons; and

G_1, G_2, G_3, and G_4 are said bridging groups, which are independently selected from the group consisting of: (a) hetero atoms selected from the group consisting of N, O, S, and P,

(b) functional groups with at least one of said hetero atoms, (c) saturated or unsaturated hydrocarbons, and (d) substituted hydrocarbons.

31. (original) The molecular system of Claim 28 comprising:



where:

A^- is an Acceptor group comprising an electron-withdrawing group selected from the group consisting of: (a) hydrogen, (b) carboxylic acid and its derivatives, (c) sulfuric acid and its derivatives, (d) phosphoric acid and its derivatives, (e) nitro, (f) nitrile, (g) hetero atoms selected from the group consisting of N, O, S, P, F, Cl, and Br, (h) functional groups with at least one of said hetero atoms, (i) saturated or unsaturated hydrocarbons, and (j) substituted hydrocarbons;

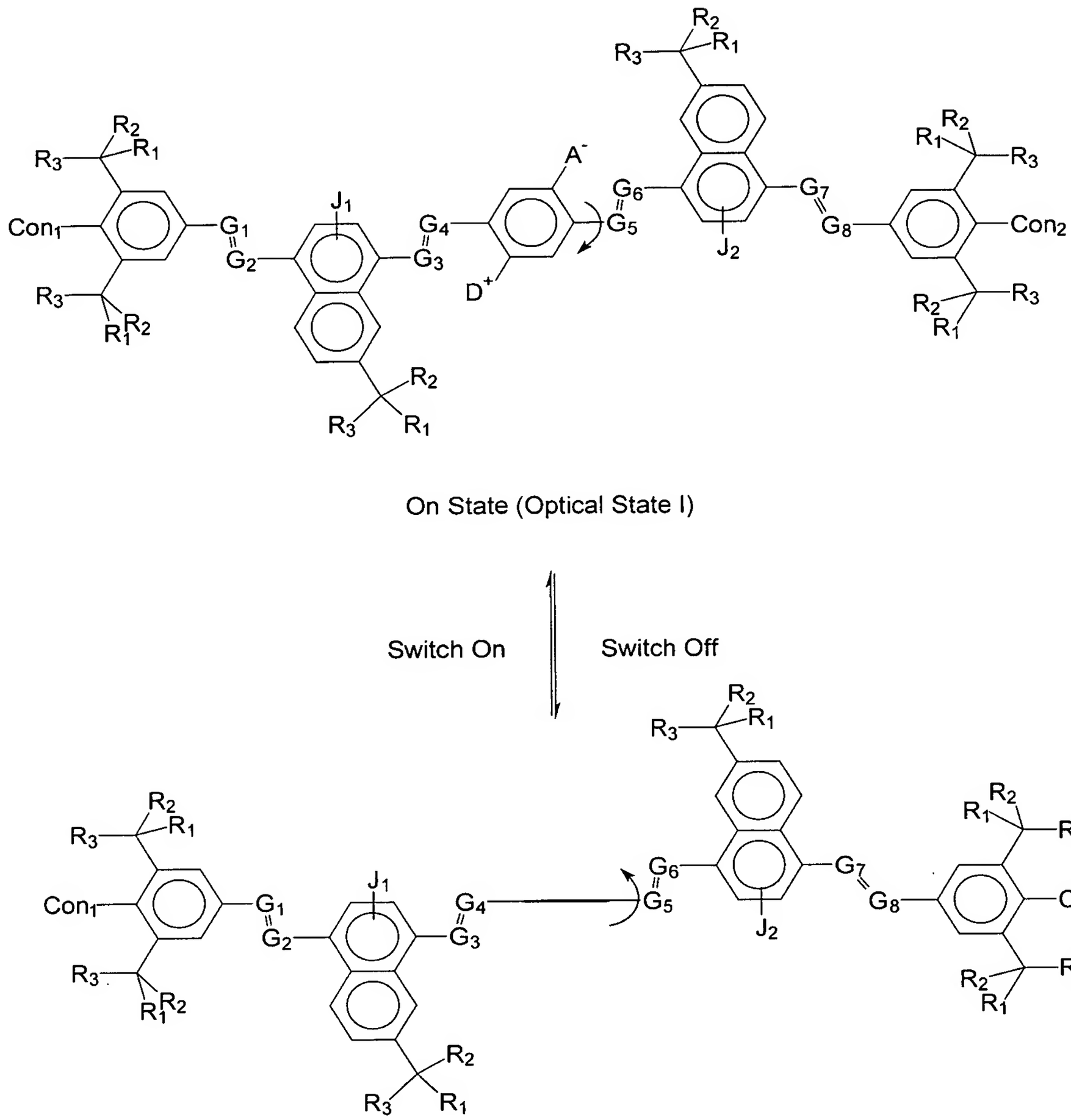
D^+ is a Donor group comprising an electron-donating group selected from the group consisting of: (a) hydrogen, (b) amines, (c) OH, (d) SH, (e) ethers, (f) saturated or unsaturated hydrocarbon, (g) substituted hydrocarbons, and (h) functional groups with at least one hetero atom selected from the group consisting of B, Si, I, N, O, S, and P, wherein said Donor group is more electropositive than said Acceptor group;

Con_1 and Con_2 are connecting units between one molecule and another molecule or between a molecule and a solid substrate selected from the group consisting of a metal electrode, an inorganic substrate, and an organic substrate, said connecting units independently selected from the group consisting of: (a) hydrogen (utilizing a hydrogen bond), (b) multivalent hetero atoms selected from the group consisting of C, N, O, S, and P, (c) functional groups containing said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons; and

SA and SB designate Stator A and Stator B, respectively, which may be the same or different and which are independently selected from the group consisting of (a) unsaturated or saturated hydrocarbons and (b) substituted hydrocarbons, wherein said hydrocarbon units contain conjugated rings that contribute to an extended conjugation of the molecule when it is

in a planar state (red shifted state), wherein said stators optionally and separately contain at least one bridging group G_n, at least one spacing group R_n, or both, wherein said at least one bridging group is either (a) selected from the group consisting of acetylene, ethylene, amide, imide, imine, and azo and is used to connect said stators to said rotor or to connect at least two conjugated rings to achieve a desired chromophore or (b) selected from the group consisting of a single atom bridge and a direct sigma bond between said rotor and said stators and wherein said at least one spacing group is selected from the group consisting of phenyl, isopropyl, and tert-butyl and is used to provide an appropriate 3-dimensional scaffolding to allow molecules to pack together while providing rotational space for each rotor to rotate over a desired range of motion.

32. (original) The molecular system of Claim 31 comprising:



where:

A^- is said Acceptor group;

D^+ is said Donor group;

Con_1 and Con_2 are said connecting units;

R_1, R_2 and R_3 are said spacing groups, which are independently selected from the group consisting of: (a) hydrogen, (b) saturated or unsaturated hydrocarbons, and (c) substituted hydrocarbons;

G_1, G_2, G_3, G_4, G_5, G_6, G_7, and G_8 are said bridging groups, which are independently selected from the group consisting of: (a) hetero atoms selected from the group consisting of

N, O, S, and P, (b) functional groups with at least one of said hetero atoms, (c) saturated or unsaturated hydrocarbons, and (d) substituted hydrocarbons; and

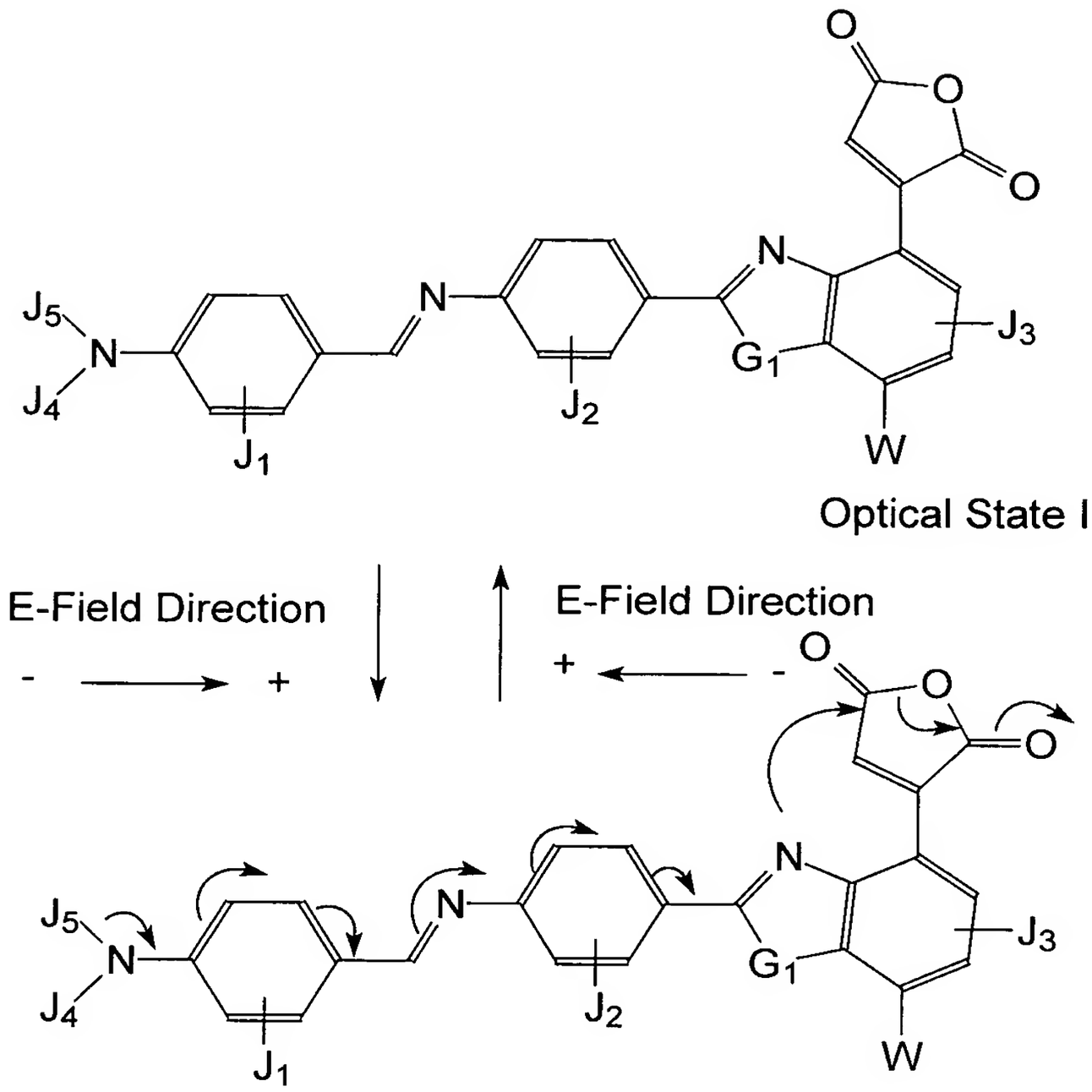
J_1 and J_2 are tuning groups to provide at least one appropriate functional effect selected from the group consisting of inductive effects, resonance effects, and steric effects, said tuning groups being selected from the group consisting of: (a) hydrogen, (b) hetero atoms selected from the group consisting of N, O, S, P, B, F, Cl, Br and I, (c) functional groups with at least one of said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons.

33. (original) The molecular system of Claim 26 wherein said electric field induced band gap occurs via a change of extended conjugation via chemical bonding change to change the band gap.

34. (original) The molecular system of Claim 33 wherein said electric field induced band gap change occurs via a change of extended conjugation via charge separation or recombination accompanied by increasing or decreasing band localization.

35. (original) The molecular system of Claim 34 comprising two portions, wherein a change from a first state to a second state occurs with an applied electric field, said change involving charge separation in changing from said first state to said second state, thereby resulting in a relatively larger band gap state, with less π-delocalization, and recombination of charge in changing from said second state to said first state, thereby resulting in a relatively smaller band gap state, with greater π-delocalization.

36. (original) The molecular system of Claim 35 comprising:



where:

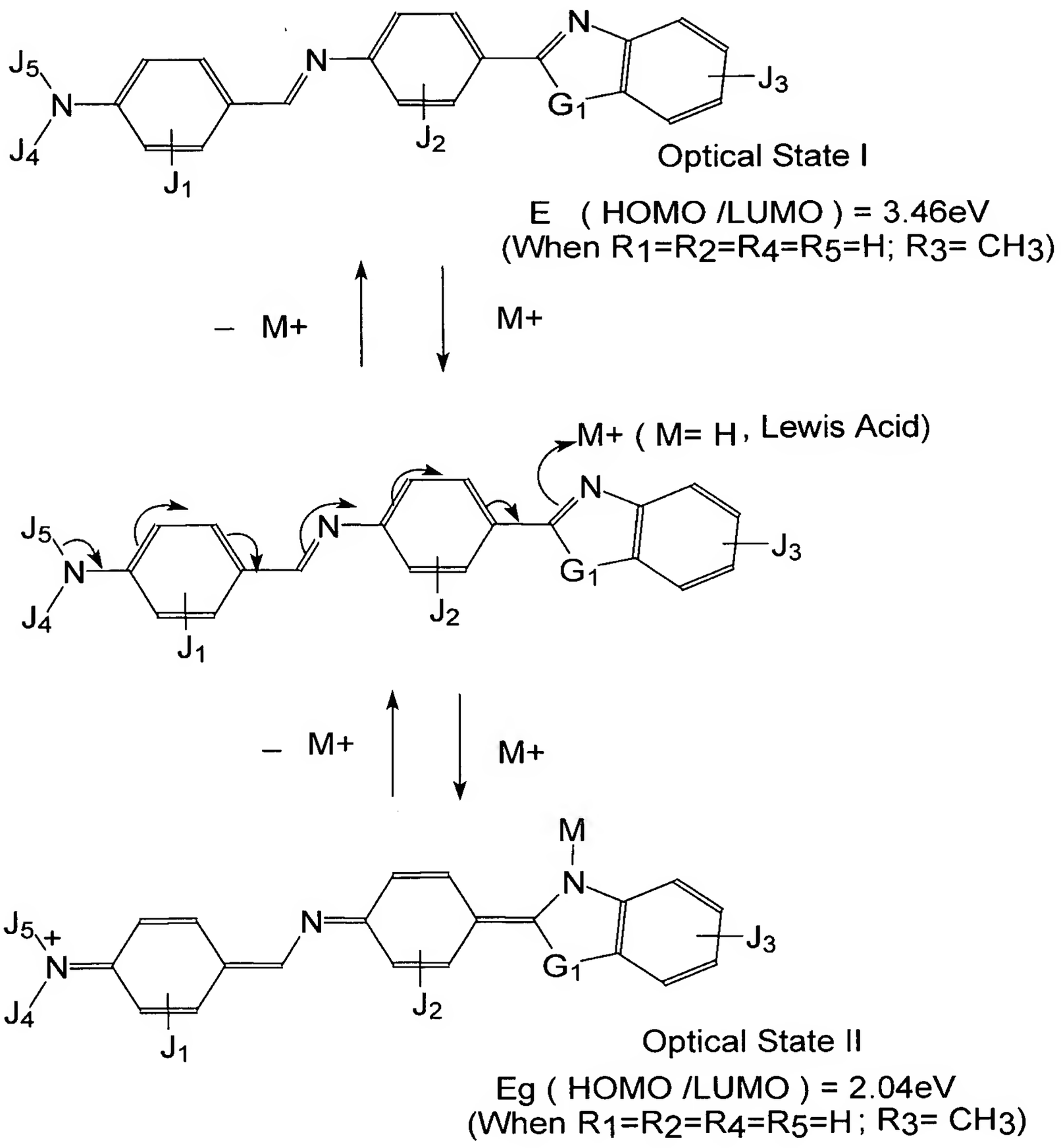
J_1, J_2, J_3, J_4 and J_5 are tuning groups to provide at least one appropriate functional effect selected from the group consisting of inductive effects, resonance effects, and steric effects, said tuning groups being selected from the group consisting of: (a) hydrogen, (b)

hetero atoms selected from the group consisting of N, O, S, P, B, F, Cl, Br and I, (c) functional groups with at least one of said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons;

G_1 is a bridging group to connect at least two conjugated rings to achieve a desired chromophore, said bridging group selected from the group consisting of: (a) hetero atoms selected from the group consisting of N, O, S, and P, (b) functional groups with at least one of said hetero atoms, (c) saturated or unsaturated hydrocarbons, and (d) substituted hydrocarbons; and

W is an electron-withdrawing group for tuning reactivity of the maleic anhydride group of said molecular system, which enables said molecular system to undergo a smooth charge separation or recombination upon application of said electric field, said electron-withdrawing group selected from the group consisting of: (a) carboxylic acid and its derivatives, (b) nitro, (c) nitrile, (d) ketone, (e) aldehyde, (f) sulfone, (g) sulfuric acid and its derivatives, (h) hetero atoms selected from the group consisting of F, Cl, Br, N, O and S, and (i) functional groups with at least one of said hetero atoms.

37. (original) The molecular system of Claim 35 comprising:



where:

J_1, J_2, J_3, J_4 and J_5 are tuning groups to provide at least one appropriate functional effect selected from the group consisting of inductive effects, resonance effects, and steric effects, said tuning groups being selected from the group consisting of: (a) hydrogen, (b) hetero atoms selected from the group consisting of N, O, S, P, B, F, Cl, Br and I, (c) functional groups with at least one of said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons;

G_1 is a bridging group to connect at least two conjugated rings to achieve a desired chromophore, said bridging group selected from the group consisting of: (a) hetero atoms selected from the group consisting of N, O, S, and P, (b) functional groups with at least one

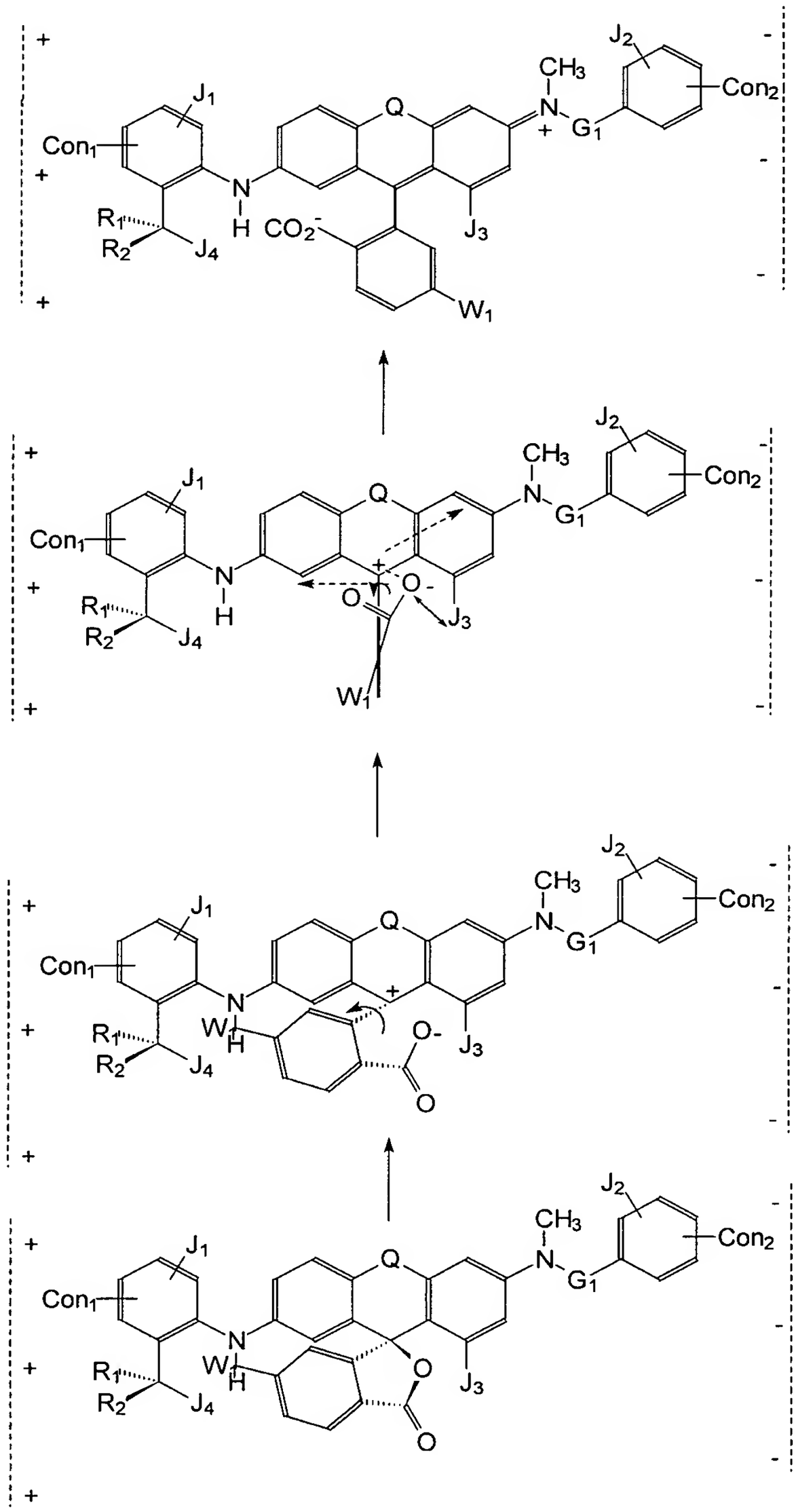
of said hetero atoms, (c) saturated or unsaturated hydrocarbons, and (d) substituted hydrocarbons; and

M^+ is selected from the group consisting of transition metals, their halogen complexes, H^+, and Lewis acids.

38. (original) The molecular system of Claim 33 wherein said electric field induced band gap occurs via a change of extended conjugation via charge separation or recombination and π-bond breaking or formation.

39. (currently amended) The molecular system of Claim 38 wherein said molecular system comprises two portions, wherein a change from a first state to a second state occurs with an applied electric field, said change involving charge separation in changing from said first state to said second state, wherein in said first state, there is extended conjugation throughout said molecular system, resulting in a relatively larger band gap state, and wherein in said second state, said extended conjugation is ~~destroyed~~ changed and separated positive and negative charges are created within said molecular system, resulting in a relatively smaller band gap state.

40. (original) The molecular system of Claim 39 comprising:



where:

Q is a connecting unit between two phenyl rings and is selected from the group consisting of: S, O, NH, NR, hydrocarbon, or substituted hydrocarbon;

Con_1 and Con_2 are connecting units between one molecule and another molecule or between a molecule and a solid substrate selected from the group consisting of a metal

electrode, an inorganic substrate, and an organic substrate, said connecting units independently selected from the group consisting of: (a) hydrogen (utilizing a hydrogen bond), (b) multivalent hetero atoms selected from the group consisting of C, N, O, S, and P, (c) functional groups containing said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons;

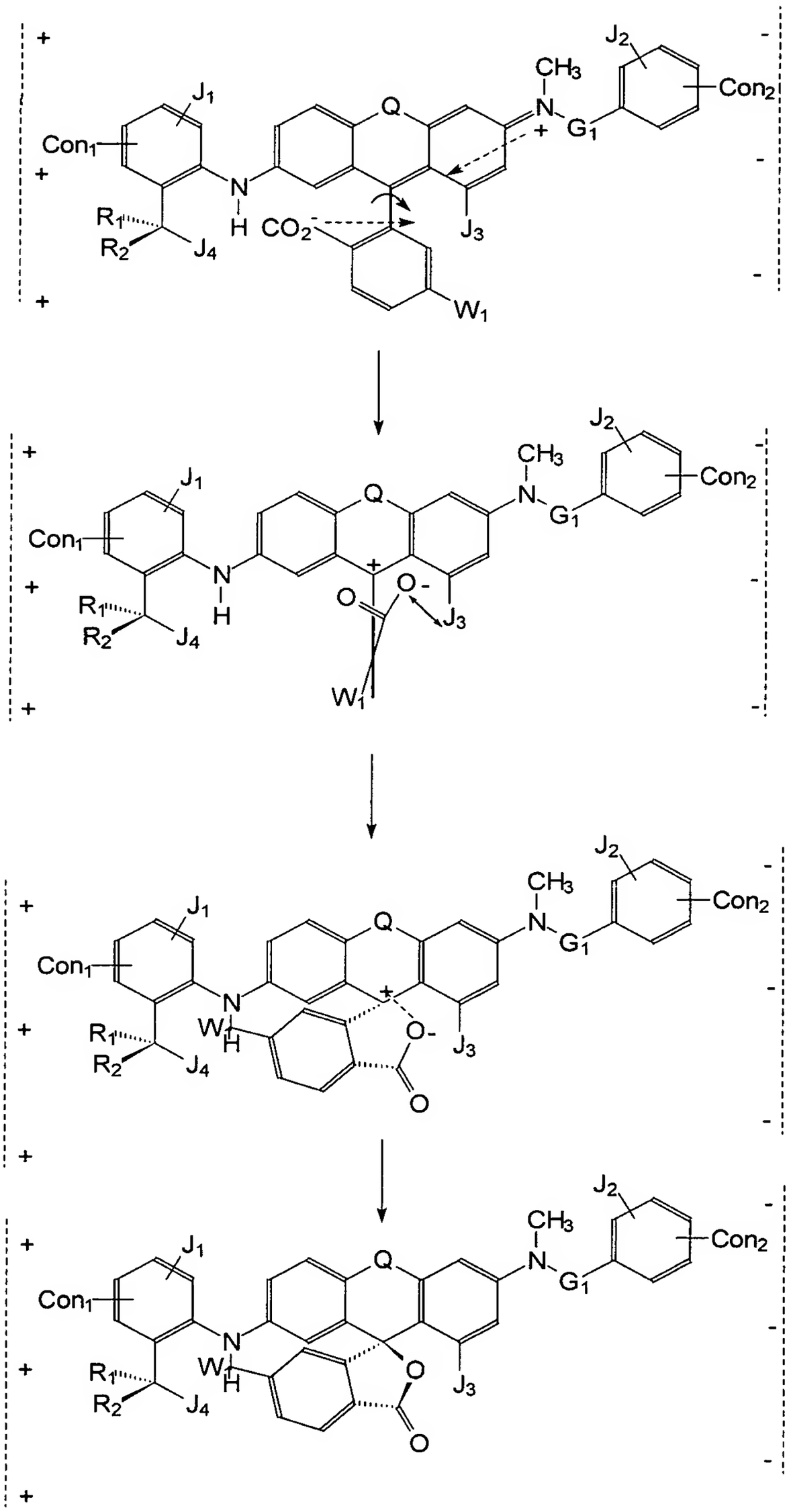
R_1 and R_2 are spacing groups for providing an appropriate 3-dimensional scaffolding to allow molecules to pack together while providing rotational space for each rotor, said spacing groups selected from the group consisting of: (a) hydrogen, (b) saturated or unsaturated hydrocarbon, and (c) substituted hydrocarbon;

J_1, J_2, J_3, and J_4 are tuning groups to provide at least one appropriate functional effect selected from the group consisting of inductive effects, resonance effects, and steric effects, said tuning groups being selected from the group consisting of: (a) hydrogen, (b) hetero atoms selected from the group consisting of N, O, S, P, B, F, Cl, Br and I, (c) functional groups with at least one of said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons;

G_1 is a bridging group to connect either (a) a stator portion and a rotor portion of said molecular system or (b) at least two conjugated rings to achieve a desired chromophore, said bridging group selected from the group consisting of: (a) hetero atoms selected from the group consisting of N, O, S, and P, (b) functional groups with at least one of said hetero atoms, (c) saturated or unsaturated hydrocarbons, and (d) substituted hydrocarbons; and

W is an electron-withdrawing group for tuning reactivity of the maleic anhydride group of said molecular system, which enables said molecular system to undergo a smooth charge separation or recombination upon application of said electric field, said electron-withdrawing group selected from the group consisting of: (a) carboxylic acid and its derivatives, (b) nitro, (c) nitrile, (d) ketone, (e) aldehyde, (f) sulfone, (g) sulfuric acid and its derivatives, (h) hetero atoms selected from the group consisting of F, Cl, Br, N, O and S, and (i) functional groups with at least one of said hetero atoms.

41. (original) The molecular system of Claim 39 wherein said molecular system comprises:



where:

Q is a connecting unit between two phenyl rings and is selected from the group consisting of: S, O, NH, NR, hydrocarbon, or substituted hydrocarbon;

Con_1 and Con_2 are connecting units between one molecule and another molecule or between a molecule and a solid substrate selected from the group consisting of a metal electrode, an inorganic substrate, and an organic substrate, said connecting units independently selected from the group consisting of: (a) hydrogen (utilizing a hydrogen bond), (b) multivalent hetero atoms selected from the group consisting of C, N, O, S, and P, (c) functional groups containing said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons;

R_1 and R_2 are spacing groups for providing an appropriate 3-dimensional scaffolding to allow molecules to pack together while providing rotational space for each rotor, said spacing groups selected from the group consisting of: (a) hydrogen, (b) saturated or unsaturated hydrocarbon, and (c) substituted hydrocarbon;

J_1, J_2, J_3, and J_4 are tuning groups to provide at least one appropriate functional effect selected from the group consisting of inductive effects, resonance effects, and steric effects, said tuning groups being selected from the group consisting of: (a) hydrogen, (b) hetero atoms selected from the group consisting of N, O, S, P, B, F, Cl, Br and I, (c) functional groups with at least one of said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons;

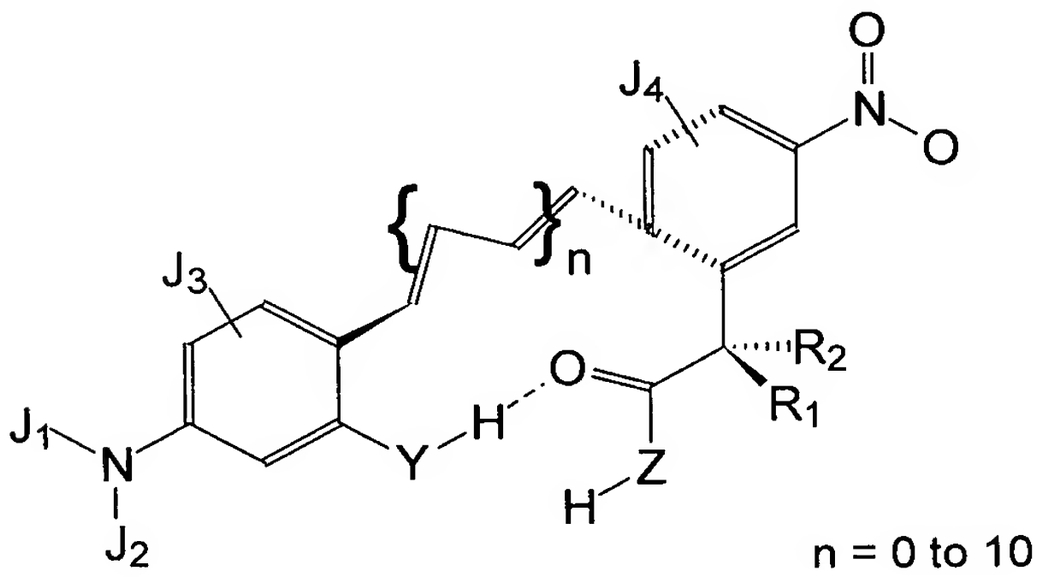
G_1 is a bridging group to connect either (a) a stator portion and a rotor portion of said molecular system or (b) at least two conjugated rings to achieve a desired chromophore, said bridging group selected from the group consisting of: (a) hetero atoms selected from the group consisting of N, O, S, and P, (b) functional groups with at least one of said hetero atoms, (c) saturated or unsaturated hydrocarbons, and (d) substituted hydrocarbons; and

W is an electron-withdrawing group for tuning reactivity of the maleic anhydride group of said molecular system, which enables said molecular system to undergo a smooth charge separation or recombination upon application of said electric field, said electron-withdrawing group selected from the group consisting of: (a) carboxylic acid and its derivatives, (b) nitro, (c) nitrile, (d) ketone, (e) aldehyde, (f) sulfone, (g) sulfuric acid and its derivatives, (h) hetero atoms selected from the group consisting of F, Cl, Br, N, O and S, and (i) functional groups with at least one of said hetero atoms.

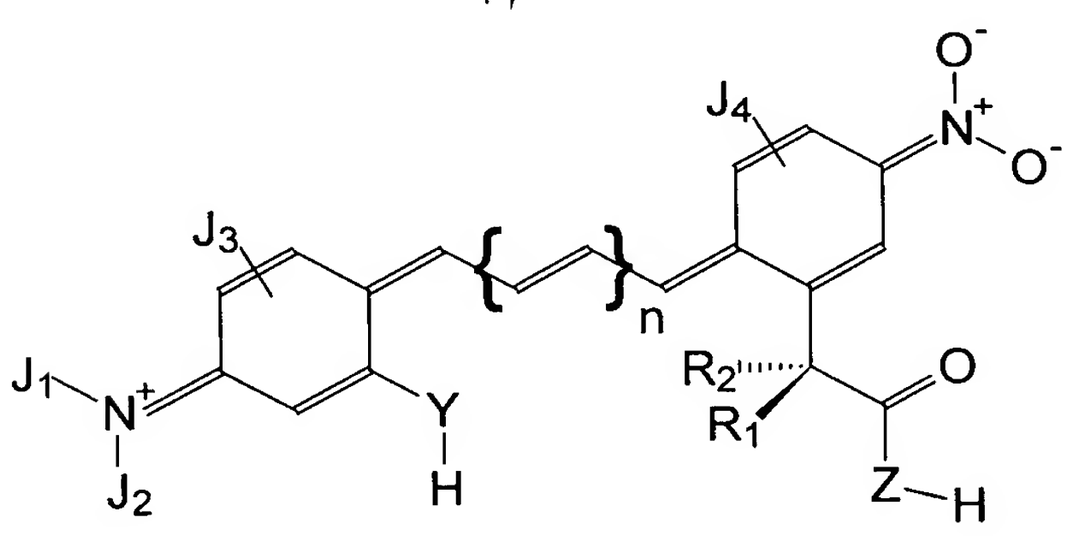
42. (original) The molecular system of Claim 26 wherein said electric field induced band gap change occurs via molecular folding or stretching.

43. (currently amended) The molecular system of Claim 42 wherein said molecular system comprises three portions, a first portion and a third portion, each bonded to a second, central portion, wherein a change from a first state to a second state occurs with an applied electric field, said change involving a folding or stretching about or of said second portion, respectively, wherein in said first state, there is extended conjugation throughout said molecular system, resulting in a relatively smaller band gap state, and wherein in said second state, said extended conjugation is ~~destroyed~~ changed, resulting in a relatively larger band gap.

44. (original) The molecular system of Claim 43 wherein said molecular system comprises:



Molecule Folding ⇌ Stretching Out



where:

R_1 and R_2 are spacing groups selected from the group consisting of: (a) hydrogen, (b) saturated or unsaturated hydrocarbons, and (c) substituted hydrocarbons;

J_1, J_2, J_3, J_4 and J_5 are tuning groups to provide at least one appropriate functional effect selected from the group consisting of inductive effects, resonance effects, and steric effects, said tuning groups being selected from the group consisting of: (a) hydrogen, (b) hetero atoms selected from the group consisting of N, O, S, P, B, F, Cl, Br and I, (c) functional groups with at least one of said hetero atoms, (d) saturated or unsaturated hydrocarbons, and (e) substituted hydrocarbons; and

Y and Z are functional groups that form inter-molecular or intra-molecular hydrogen bonding and are selected from the group consisting of: (a) SH, (b) OH, (c) amine, (d) hydrocarbons, and (e) substituted hydrocarbons.